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Increasing Service Quality at a University: A Continuous Improvement Project

Abstract

Purpose—This paper evaluates a continuous improvement project (CIP) at a Mexican university designed to increase engineering graduate student loyalty.

Design/methodology/approach—A plan-do-check-act problem-solving methodology was implemented, and a SERVQUAL survey was conducted on 67 master's engineering students.

Findings—Five factors were found to affect student loyalty: facility cleanliness, faculty teaching skills, evening student services, master's degree student management roles at work and master's degree students' ages. After the implementation of the improvement and control actions, there was a 7.7% increase in the engineering master's degree students' loyalty scores.

Originality—This research work took a different approach in assessing student satisfaction and student loyalty in a higher education institution (HEI) by using the SERVQUAL survey as the data collection instrument for the conduct of the CIP.

Research limitations—However, there were several research limitations: data availability (such as student loyalty, student satisfaction and a small master's degree student population size) and factors outside the CIP's scope (such as the country's economic situation, university rankings, master's programme accreditations and COVID-19).

Practical implications—The findings from this research study could be used by other HEIs to improve student loyalty and as a reference when conducting similar studies in other service organisations such as hospitals and hotels.

Keywords—SERVQUAL, improvement project, perceived quality, service quality, higher education, PDCA

1. Introduction

Because of increased organisational requirements and the rising number of professionals with bachelor's degrees, master's degrees, doctoral programmes and specific certifications, these qualifications having become critical differentiators when filling job vacancies. As this employment situation has led to an increase in the demand for graduate degrees and university offers, higher education institutions (HEIs) have begun to focus on service quality to increase their competitiveness and attract new graduate student applications (Sultan and Wong, 2011; Choudhury, 2015).

HEIs are complex because of their various services, suppliers (internal and external) and stakeholders (Van Riel et al., 2013; Li et al., 2019). Low service quality in HEIs, which can affect student satisfaction and loyalty (Farahmandian et al., 2013; Ali et al., 2016), is caused by restrictive administrative processes and poor ability to resolve issues (Alvarado Peña et al., 2015).

While some studies have identified the independent variables related to service quality, the associated implementation actions were not explored to assess the service quality improvement impacts as continuous improvement projects (CIPs). CIPs, such as Kaizen events, Six Sigma, Lean Six Sigma, and quality improvement methodologies, were developed decades ago to enhance processing performance in manufacturing organisations (Gonzalez Aleu and Garza-Reyes, 2020). However, their application in HEIs to address service quality and improve processes has been relatively recent (Li et al., 2019; Asnawi and Setyaningsih, 2020; Cudney and Furterer 2020).

There are several problem-solving methodologies that could be applied to CIPs, such as Define – Measure – Analyse – Improve – Control (DMAIC), which requires advanced statistical tools (repeatability and reproducibility studies, design of experiments and control charts) and plan-do-check-act (PDCA), which uses basic tools (data collection sheets stratification, Ishikawa diagrams and Pareto diagrams).

SERVQUAL, a multi-dimensional research instrument that can reveal service quality expectations and perceptions in five dimensions, has been widely used to assess student satisfaction in HEIs in Thailand and Russia (Yousapronpaiboon, 2014; Galeeva, 2016); to

measure public higher education administrative processes (Soares et al., 2017) and to measure and evaluate special higher education courses (Tóth and Surman, 2019). However, few studies have examined graduate student loyalty and graduate student enrolment under a CIP umbrella.

Thus, to go some way towards filling this research gap and considering the lack of historical data (as will be discussed in Section 5) to conduct advance statistical analysis, this paper applied a PDCA problem-solving methodology and SERVQUAL to determine graduate student loyalty and enrolment at a Mexican university.

2. Literature review

HEIs are complex service organisations with various stakeholders: students, parents, faculty, alumni, administrative personnel, funding agencies, government, hiring organisations and the community (Choudhury, 2015; Li et al., 2019). Each of them has a distinct meaning of quality (Harvey and Green, 1993). Thus, almost every process involves some sort of human interaction, which increases the probability of a negative service quality experience (Li et al., 2019) during the years students take to complete their undergraduate or graduate degrees, which, in turn, could adversely affect higher education performance metrics, such as student satisfaction and loyalty (Annamdevula and Bellamkonda, 2016; Chandra et al., 2018).

Service quality, which is a common metric for measuring organisational performance, has been defined as the overall assessment of an organisation's service on the basis of the difference between a consumer's perceptions and their initial expectations (Santos, 2003; Hung et al., 2003). Zeithaml et al. (1990, p.26) studied service organisations and developed SERVQUAL, a service quality assessment instrument.

SERVQUAL is organised around five dimensions: (a) tangibles (items 1–4), which deals with perceptions regarding the facilities, equipment, personnel and communication materials; (b) reliability (items 5–9), which focuses on the ability to effectively perform the promised service; (c) responsiveness (items 10–13), which reflects the willingness to assist customers and provide prompt service; (d) assurance (items 14–17), which focuses on the knowledge and courtesy of employees and their ability to convey trust and confidence and (e) empathy (items 18–22), which reflects the individual attention provided to customers.

SERVQUAL and SERVQUAL adaptations have been used to assess higher education service quality in several countries and to identify the relationships between overall satisfaction or loyalty and SERVQUAL's five dimensions. The tangibles and responsiveness service quality dimensions were significant in Thai universities (Yousapronpaiboon, 2014). The assurance dimension was closely related to service quality in some public universities in México (Alvarado Peña et al., 2015). Supportive infrastructure (i.e. food court, library and transportation) and facility conditions (cleanliness and maintenance) were leading service quality metrics in Russian and Turkish universities (Galeeva, 2016; Abbas, 2020). Student satisfaction and loyalty were related to perceived student value in Mauritian HEIs (Teeroovengadum et al., 2019). Safety and security were identified as two new service quality metrics in Turkish HEIs (Abbas, 2020). Depending on student seniority and student education levels, in Indonesian universities, there were different quality dimensions related to teaching capability and competence, service reliability, library service support and university reputation (Asnawi and Setyaningsih, 2020).

Other studies on service quality have found higher education student loyalty to be affected by student satisfaction (Thomas, 2011), price fairness, perceived value and service quality (Goh et al., 2017) as well as student background (Abuhassna et al., 2020).

Nevertheless, none of these studies examined efforts to improve service quality, and generally, just a handful of studies have addressed Lean Six Sigma project improvements in HEI performance metrics on student satisfaction levels (Haerizadeh and Sunder, 2019), cost reductions (O'Reilly et al., 2019), different service processes (Li et al., 2019; Cudney and Furterer, 2020) or student dropout rates (Gupta et al., 2020).

The Deming cycle or the PDCA problem-solving methodology appeared in manufacturing organisations in the 1950s (Walton, 1998) and were found to successfully address several challenges, such as productivity improvements, defect reductions and customer satisfaction (Deming, 1982; Realyvasquez-Vargas et al., 2018). The PDCA problem-solving methodology was subsequently introduced in other sectors, such as healthcare, software development and education (Pittman and Russell, 1998; Venkatraman, 2007; Kennedy, 2008). However, few CIPs have used the PDCA problem-solving methodology to improve student satisfaction, student loyalty, student enrolments and other service quality metrics, with next to no PDCA higher education studies linking TQM and continuous improvement

programmes (Venkatraman, 2007) to pedagogical methodological improvements (Koh and Choi, 2016) or sustainability (Olariu et al., 2020).

3. HEI profile

This research study focused on a Mexican HEI that has 14,000 students, offers 46 undergraduate degree programmes, 15 master's degree programmes, 15 graduate specialities and 35 medical specialities across six schools: (1) Art, Architecture and Design, (2) Education and Humanities, (3) Business, (4) Health Sciences, (5) Law and Social Sciences and (6) Engineering and Technology.

The CIP reviewed in this paper was implemented at the Graduate School of Engineering and Technology (SET), which offers three executive master's degree programmes: Product Engineering (MPE), Industrial and Systems Engineering (MISE) and Engineering Management (MEM). The MPE students should be able to apply scientifically rigorous methodologies, such as mathematical modelling, tribology, structural optimisation and finite element analysis to design and validate products. MISE students require an integrated vision to solve organisational problems using operations management, lean thinking and Six Sigma. MEM, which was first opened in 2015 as a result of the low growth rate from the other two master's programmes, provides students with the skills to lead different organisational departments to achieve the organisation's mission and objectives. Each master's student must take 10 subjects, attend one research seminar and conduct an applied investigation (thesis) to solve a specific manufacturing or service organisation problem.

4. Research method

Some conditions that justify the utilisation of single-action research or single-case study are that the experiment represent an extreme or unique case, representative or typical case or a longitudinal case (Yin, 2008). This research study addressed all three criteria. First, because of the dearth of studies integrating SERVQUAL and the PDCA cycle in an HEI in México, this research work is unique. Second, customer loyalty and satisfaction have been common areas of focus in service organisations, such as HEIs. Third, the CIP implementation allows for longitudinal assessment by the comparison of the metrics before and after the

improvement actions. Therefore, because of these three reasons, the authors decided to use this research methodology.

Action research is a systematic protocol or method that involves the researchers identifying and investigating everyday problems in situ and then developing an effective solution. That is to say, in action research, the researchers participate in the improvement process (Stringer, 2007). Because CIP is a systematic approach to improve process performance metrics over a relatively short time by using a cross-functional team (Gonzalez Aleu et al., 2018), the research team decided to use the action research approach.

Stringer (2007) proposed a three-phase action research approach that involved seven main steps: (1) collecting relevant information; (2) describing the current situation; (3) exploring and analysing the current situation; (4) interpreting findings; (5) creating an action plan; (6) implementing solutions and (7) evaluating the solution's impact. For this action research, these seven steps were grouped in the four PDCA problem-solving approach phases (Realyvasquez-Vargas et al., 2018), as follows:

a) **Plan (P)**. This phase involved all CIP planning activities related to defining solutions, for which SERVQUAL was used to collect service quality and student loyalty information from the graduate SET students.
b) **Do (D).** This phase involved all activities related to the CIP improvement action implementations, which included a pilot test.
c) **Check (C).** This phase included the CIP improvement action validation of the CIP goals.
d) **Act (A).** This phase included effectiveness assessment of improvement actions and standardisation of improvement actions.

During these four phases, several graphics (SIPOC and fishbone) and statistical analysis (descriptive statistics, analysis of variance [ANOVA], multi-regressions, etc.) tools were utilised. Each of these four stages was extensively addressed to document the CIP in the SET.

5. Results

5.1 Plan

5.1.1 Problem

From 2008 to 2012, SET master's degree students (SET-MDSs) enrolment was decreasing (see Table I), which prompted SET to apply to a new graduate programme director (GPD) at the end of 2012. Under their new leadership, SET-MDS enrolment increased and MEM was developed and launched in 2015, which significantly increased the student intake (83%). However, if MEM's first-year student enrolments were removed from the analysis, there was a decrease of seven students (−23%) in 2015 (see Table I). Thus, a CIP was developed and implemented in January 2016.

Table I. SET master's degree student enrolment from 2008 to 2015 – [Insert Here].

SET-MDS alumni were surveyed in 2014 to understand their motivations for acquiring the master's degree and their satisfaction with the master's programmes. The survey resulted in six insights: (i) they had not acquired an adequate level of knowledge (including professional, cultural and auto-study skills); (ii) they were not satisfied with the car parking; (iii) contact with international classmates and/or international professors had been lacking; (iv) they had found high academic standards to be lacking (v) they had not felt engaged to collaborate with the university; and (vi) most said that they would not choose to study again at this university if an opportunity arose. Although few SET alumni participated in the study (six out of 184 participants), the evidence revealed that there was poor overall satisfaction and loyalty.

5.1.2 CIP team and stakeholders

The GPD (CIP leader) selected a four-member cross-functional team: two faculties, who were responsible for faculty data collection and statistical analyses; a marketing staff, who was responsible for alumni data collection; and a graduate teaching assistant, who was responsible for SET-MDS data collection. The CIP team then identified the following stakeholders: current and future master's degree student employers, the SET dean, and other university leaders and faculties.

5.1.3 CIP timeline

A seven-month chart timeline was developed to define the CIP activities and CIP team members responsible during the four stages: Plan (3 months), Do (2 months), Check (1 month) and Act (1 month).

5.1.4 Process mapping

The CIP team developed a supplier, input, process, output and customer (SIPOC), from which three insights were gained: suppliers outside the Mexican university must be involved in further CIP, a list of potential independent variables related to student satisfaction and loyalty and multiple customers (i.e., students, organisations, government and community) should be considered to increase the attractiveness of the SET master's degree.

5.1.5 Data collection, data screening and reliability

Because of the lack of available information regarding SET student satisfaction and loyalty, the CIP team decided to use the SERVQUAL survey. Several adapted SERVQUAL versions have been used in HEIs (Gallifa and Batalle, 2010), which have been found to be reliable (Cronbach's alpha > 0.7). Thus, a paper-based survey based on SERVQUAL was developed by the CIP team that had three main sections: four demographic information questions (completed master's degree programme, gender, age, and current professional role); 24 SERVQUAL questions that used a five-point Likert scale to assess respondents' satisfaction across the five dimensions of tangibles (eight questions), reliability (four questions), responsiveness (four questions), assurance (three questions) and empathy (five questions) and two overall student loyalty questions on a scale of 0 to 10.

The anonymous data collection instrument was applied in Spring 2016, and it was completed by all 72 enrolled students (100% response rate). First semester students were not included in the data collection because of their lack of contact with SET and the university administrative processes. Three criteria were used for data screening (Hair et al., 2017): removing respondents with 15% or more missing data, removing questions with 15% or more missing data, and removing suspicious response patterns (five surveys with suspicious response patterns were eliminated). Therefore, 67 valid responses were included in the analysis and used to assess SERVQUAL instrument reliability (Cronbach's alpha = 0.78),

which was higher than 0.7, the minimum suggested (Hair et al., 2017). Thus, the SERVQUAL instrument used in this research study was found to be consistent; that is to say, it measured what it was supposed to measure.

5.1.6 Demographic information

The survey included questions on four demographics—master's programme being studied, gender, age and current professional role—with the results being as follows:

- MEM (30 respondents), MISE (19 respondents) and MPE (14 respondents). Four respondents did not answer this question.
- Most respondents were male (45 respondents), and two respondents did not answer this question.
- The majority of the respondents (58 respondents) were between 20 and 35 years old.
- Most respondents had mid-level professional positions from supervisors to managers (49 respondents).

5.1.7 Descriptive analysis

Table II presents the overall service quality perception and expected results. From the service quality perception items, the statement 'I feel safe at Mexican university facilities' (mean = 4.51; SD = 0.68) had the highest score, whereas the 'Accessibility to car park' survey item (mean = 2.42; SD = 1.15) had the lowest. After grouping service quality perception items in each of the five dimensions, it was observed that the reliability dimension (mean 4.25; SD = 0.70) was the highest and the tangibles dimension (mean 3.51; SD = 1.11) was the lowest. However, from the service quality expectation items, 'Ability of professors to share knowledge' (mean = 4.91; SD = 0.29) had the highest score and 'Availability of library staff to fulfil student needs' (mean = 3.94; SD = 0.83) had the lowest. The grouping of the service quality expectation item in each of the five dimensions found that the reliability dimension (mean = 4.63; SD = 0.57) was the highest, and the empathy dimension (mean = 4.33; SD = 072) was the lowest. Thus, the descriptive analysis suggested that SET-MDSs expected to receive high-quality education and that they were currently satisfied with this (reliability dimension).

Table II. Gap between service quality perceptions and service quality expectation – [Insert Here]

The master's degree student loyalty was assessed to have an overall mean of 8.76 (SD = 1.55) on a 10-point scale. Two questions were used to assess student loyalty on a 10-point scale: 'How proud do you feel to be a future alumnus?' (mean = 8.69; SD = 1.49) and 'How likely is it that you would recommend the master's programme to a friend, colleague or family member?' (mean = 8.82; SD = 1.61). Although both questions had a high value, they also had a high standard deviation, which indicated that there was a low level of loyalty in two SET-MDSs, who scored 5 for both questions.

5.1.8 CIP goal

As mentioned in the literature review section, service quality is related to student satisfaction and loyalty. Thus, using the collected information to assess master's degree student loyalty, the CIP team defined a goal to increase the loyalty metric 'How proud do you feel to be a future alumni?' from 8.69 to 9.00 (3.6%). Although there were no historical data to establish a goal using the entitlement equation, the CIP team determined that the 9.00 score was its goal because the MODA from the 67 surveys was 9.00.

5.1.9 Cause–effect analysis

The GPD coordinated a focus group with four students, three faculty members, one research assistant and one staff member to perform a cause–effect analysis to identify the potential causes of the poor loyalty. Five potential root causes were found and classified in SERVQUAL dimensions: 'faculty without teaching skills' (reliability), 'bathrooms and classrooms not clean' (tangibles), 'no student services at night' (empathy), 'equipment and machines in laboratories do not work' (tangibles) and 'insufficient computers with specialised software' (tangibles). A multiple regression analysis was conducted to validate these potential root causes.

5.1.10 Potential root cause validation

Three main analyses were conducted to validate the potential root causes: a multi-regression analysis, identification of the gaps between the student perceptions and expectations and ANOVAs on the demographic information.

First, to conduct the multi-regression analysis, student loyalty (two items) was regarded as the dependent construct variable, and three independent construct variables were identified by calculating the gap (student perceptions vs. student expectations) in the respective SERVQUAL dimensions: tangibles gap (eight items), reliability gap (four items) and empathy gap (five items). These three constructed independent variables were obtained from the cause–effect analysis. The multi-regression model is statistically significant ($p = 0$), showing an R^2 and adjusted R^2 scores of 0.38 and 0.34, respectively. The three independent construct variables were also statistically significant: tangibles ($p = 0.04$), reliability ($p = 0$) and empathy ($p = 0.01$). Thus, the CIP team defined these three dimensions as the key construct variables related to student loyalty. However, additional analyses must be conducted to validate the potential root causes.

Second, the higher the negative gap the more significant the improvements needed in that dimension (see Table II). Most of the opportunities to improve were found in the tangibles dimension. In particular, it was found that the Mexican university must pay attention to 'access to the car park' (gap = −2.22), 'W.C. cleanliness' (gap = −1.09), 'classroom cleanliness' (gap = −1.06) and 'current material available in the digital library' (gap = −0.81). Other opportunities for improvements were found in two items from the reliability and responsiveness dimensions; 'ability of professors to share knowledge' (gap = −0.75) and 'opportune information about services offered by the university' (gap = −0.75). These findings validated two of the five potential root causes: 'faculty without teaching skills' and 'bathrooms and classrooms are not clean'.

Last, four ANOVAs were conducted for each gap mean dimension to test the hypotheses in Table III and identify the statistically significant differences between the demographic groups. With a set $p < 0.05$, these analyses indicated a statistically significant difference between the respondents' professional roles in the gap mean for the reliability dimension ($p = 0.040$) and between the respondents' ages in the gap mean for the responsiveness

dimension ($p = 0.038$). This finding indicated that the master's degree students with high management roles had higher expectations for the quality of knowledge they perceived to have obtained. Because this gap mean indicated that the reliability dimension was related to the faculty capacities to share their knowledge, the CIP team considered that this analysis again supported the root cause, 'faculty without teaching skills'. For the gap mean responsiveness dimension, the three respondent age groups gap mean values were −0.54 (20–25 years old), −0.29 (26–30 years old) and −0.96 (more than 30 years old), which suggested that master's degree students who were >30 years old expected a greater focus on problem-solving skills and more connection to the GPD and staff. Thus, this last analysis of the gap mean for responsiveness validated the third root cause, 'there are no student services at night'.

Table III. Gap mean hypothesis tests – [Insert Here]

After these three analyses, the CIP team had validated three of the five identified potential root causes, wherefrom it was decided that the definition for the improvement actions should be focused on eliminating the following root causes: 'bathrooms and classrooms are not clean', 'faculty without teaching skills' and 'no student services at night'.

5.2 Do

The CIP team worked with different stakeholders at the university to perform several actions focused on eliminating each root cause that did not require a financial investment.

5.2.1 Root cause #1: 'Bathrooms and classrooms are not clean'

Three main actions were implemented to eliminate root cause #1: reinforce the Mexican university policy of 'no eating inside the classroom' with all SET faculties and students; design new bathrooms and classrooms cleaning schedule, from 17:00 and 18:00 h (an hour before the beginning of graduate-level courses); and offer faculties bathrooms (capacity: six men and six women per floor in a four-storey building) to SET-MDSs

5.2.2 Root cause #2: 'Faculties without teaching skills'

A total of 16 faculties (all with Ph.D.'s) were employed to cover the courses required in the three master's degrees. These faculties were 81.25% part-time (13 from industry) and 18.75% from SET (three currently teaching full-time at SET). The following actions were developed for all SET faculties: substitute part-time faculties with the lowest performance for full-time faculties with industry experienced ones; request the institutional pedagogical model certification (includes: 50 hours of pedagogical methodologies training and 100 hours in course redesign); attend the SET pedagogical conference every semester (4 hours) and design and implement workload balance policies (one graduate-level course per faculty).

5.2.3 Root cause #3: 'There are no student services at night'.

Four main actions were implemented to eliminate root cause #3: reschedule the GPD office hours rescheduled (9:00 to 19:00) to receive SET-MDSs or prospects and help them with any concerns; hire a graduate assistant with a bachelor's degree from a Mexican university to help the GPD in SET master's programmes promotion events and solve SET-MDSs' university services questions; offer the faculty car park to SET-MDSs, speed up access to classroom and elimination of SET-MDS parking cost and establish an enrolment kick-off meeting to introduce several university stakeholders.

5.3 Check

All improvement actions were implemented over Autumn 2016. Then, to verify the impact of these improvement actions on student loyalty, a survey was conducted on graduate SET students in their last semester in Spring 2017 (n = 7, full generation), wherefrom the following were found: the loyalty item 'How proud do you feel to be a future alumni?' increased from 8.69 to 9.83 (13.1%), 100% of the master's degree students claimed that they would recommend a master's degree from SET on their social networks, and all master's degree students assessed the item 'faculty quality is satisfactory' with a 5 on the five-point Likert scale. Thus, because of these results, the CIP team decided to move to the Act phase.

5.4 Act

Several actions were developed to sustain the results obtained from the previous phases: the no food policy was to be stressed at the beginning of each semester in SET undergraduate courses (see Sub-section 5.2.1), with an updated cleaning inspection record for classrooms and bathrooms with the new hours established (5.2.1), a documented workload institutional policy procedure for part- and full-time faculty was implemented (5.2.2.a and c), at least 40 h of training per year in pedagogy methodologies included in the full-time faculty annual assessment (5.2.2.b), the changes in the GPD office hours communicated to the Human Resource department (5.2.3.a), the funding for a graduate assistant included in the GPD budget (5.2.3.b) and an open-house meeting every semester with various university departments (e.g. scholar and security) included in the GPD role description (5.2.3.c and d). SET also decided to implement three initiatives to improve process standardisation and increase exposure related to the institutionalisation of a survey to measure the impact of the master's degree on the students' professional lives and student loyalty (called 'Proudly Alumni'), a national certification for each master's programme (2017, Product Engineering, 2018, Industrial and Systems Engineering, and 2019, Engineering Management) and participation in national rankings.

In Autumn 2017, the loyalty item in the 'Proudly Alumni' survey reported (n = 26) a 9.36 out of 10 for the item 'How proud do you feel to be a future alumni?', which was an increase of 7.7% on the CIP goal, and 96% of the master's degree students claimed that they would recommend a SET master's degree on their social networks. On the basis of these metrics, the CIP team decided to document its work as an action research study and closed the CIP project.

6. Discussion

The GPD claimed that the CIP success was because of the CIP team's willingness to have a strong impact, the CIP cross-functional team constitution and the involvement of the different departments in framing solutions. However, the main barrier or limitation was related to the lack of historical information, which had caused delays in CIP duration, which initially was planned to 6 months but had overshot to 12 months. This supports the findings from Gonzalez Aleu et al. (2018), who identified data availability and data trustworthiness as critical success factors related to CIP success in hospitals and different service organisations.

As the CIP was closed in December 2017 after the Act phase, the authors decided to update the SET-MDS loyalty in 2018 and 2019, wherefrom it was found that in three of the four semesters, the student loyalty scores were equal to or higher than the scores obtained during the Act phase. The low score reported in Spring 2018 (8.86) came from the only MPE student who scored the question 'How proud do you feel to be a future alumni?' with a 5 out of 10. However, the same student answered the question 'Would you recommend the university for study in a SET master's degree?' with a YES; therefore, this response was considered a mistake and no further actions were needed.

As mentioned in the Plan phase, there had been low enrolments in the SET master's degree programmes. Thus, based on the literature, the CIP team decided to focus on student loyalty to increase the attraction to the SET master's degree programme. Information from the admissions department reported to the GPD 87 enrolees in 2018, which was a 55% increase over 2017. The authors believe that this improvement was a consequence of different factors, such as student loyalty, national programme accreditations, national rankings and international exposure in conferences. Further work is required to assess how these factors impacted the increase in attraction to the SET master's degree programme.

In 2019, the master's programme enrolled only 49 new students, which was a 77% decrease over 2018. This lack of attraction in 2019 was due to the GPD creation of an Industry 4.0 and data analytics certification (more than 100 h of training), which had been identified as a gap in the current master's programme designs. In March 2020, when the authors were writing this paper, the COVID-19 pandemic meant that the master's degree courses had to be moved to an online format. Although the master's degree students were kept in the online format until Autumn 2020, the university established a financial fund for master's degree students having financial problems because of COVID-19. The authors believe that this action taken by the university could impact master's degree student attraction, and therefore, future work is required to investigate best practice towards reduce the impact of COVID-19 on the on-campus undergraduate and graduate programmes.

This study increases research into CIP in HEIs from practitioner and theoretical perspectives. From a practitioner's perspective, this study offers four main contributions; that is to say, the lack of historical data can lead to longer CIP durations. Service organisations, such as hospitals and HEIs, have large human interaction components that impact customer

satisfaction and/or loyalty (Li et al., 2019). SIPOC helped the CIP team identify all the main actors (or departments) that had contact with the master's degree students. Statistical and non-statistical tools can be used to identify potential root causes and to validate these root causes. Eight of the nine improvement actions did not require any investment, and the return on investment was validated.

Theoretically, this study offers the following insights. First, this paper confirmed the findings in Zeshan et al. (2010) and Yousapronpaiboon (2014), who both found that in HEIs, the highest gap was in the tangibles dimension. However, this study also contradicted the findings of the same studies that found the reliability dimension to be the lowest gap; in this study, the empathy dimension had the lowest gap. Second, this study proved the relevance of regression analyses in identifying the SERVAQUAL dimensions related to student loyalty (Tan and Kek, 2004). Teeroovengadum et al. (2019) also found that loyalty could be improved by improving student perceptions of university value received. A university's image is related to the tangibles dimension (see Table II) and includes considerations such as classroom appearance, bathroom and classroom cleanliness and laboratory facilities. Value received is related to the reliability dimension (see Table II) and includes student plan fulfilment, shared current knowledge and faculty skills. Thus, both the tangibles and reliability dimensions were found to be statistically significantly related to student loyalty. Third, this CIP supported the findings of Abuhassna et al. (2020), who found that student background impacted student satisfaction and loyalty. The ANOVAs revealed statistically significant differences in graduate SET-MDSs with high management roles, who were found to have higher expectations of the quality of information (knowledge gained) they perceived they had obtained (reliability dimension) and in SET-MDSs >30 years old, who expected more problem-solving skills and connection to the GPD and staff (responsiveness dimension). Last, student satisfaction and loyalty were found to be influenced by student demographics, such as gender and current job role (first line, professional, manager etc.).

HEI quality could have the following interpretations: quality as exceptional, quality as perfection or consistency, quality as fitness for purpose, quality for money, and quality as transformation. That the tangible responsiveness dimensions had the highest gap (see Table II) suggested that the students viewed themselves as customers, with the primary focus being on 'the student journey' rather than the knowledge being gained or the effect on their

professional careers. Additional analysis is needed to further examine the impact of the following factors on student satisfaction and loyalty: previous graduate student contact with the HEI (undergraduate alumni vs. not), and graduate tuition payments (individual vs. scholarship). These analyses could assist in better understanding student satisfaction and loyalty from a 'quality as value for money' perspective.

7. Conclusions

The CIP presented in this study was primarily focused on increasing SET-MDSs' loyalty, an area hitherto not addressed in several CIP studies. Because of the initial lack of information about student loyalty, the CIP team integrated the SERVQUAL tool into the PDCA problem-solving methodology as the data collection tool to assess SET-MDSs' perceptions, expectations and loyalty. This approach contribute to CIP goal achievement.

Although this study offers both theoretical and practitioner contributions (Section 6), these results could not be generalised, considering that this was a single-case study in the SET graduate programme (focused on part-time students) in México situated in a specific socio-economical context. For example, although student loyalty and student enrolments increased, as the authors did not prove causality, there may have been other factors outside this CIP that could impact student enrolments, for example, the country's economic situation, university rankings and master's programme accreditations.

In addition to the lack of historical data mentioned (see Section 6), the other limitation of this study was the relatively small SET-MDS sample population rather than the full SET-MDS population. Although the CIP goal was exceeded, combining the PDCA problem-solving approach and SERVQUAL is not the only way to address this problem. Therefore, further HEI research should be focused on four main areas: the impact of additional student satisfaction and loyalty demographic factors, such as previous graduate student contact with HEI and graduate student tuition payments; the relationship between student satisfaction and loyalty based on other Harvey and Green (1993) quality interpretations, such as transformation or perfection; the benefits of full 5S's (as translated from the Japanese: organise, orderliness, cleanliness, standardisation and discipline) implementation in an HEI and the impact student loyalty has on student enrolment using another CIP, such as Lean Six Sigma. However, given that many of these require several months of work, further research

should be focused on understanding the benefits of using agile problem-solving methodologies, such as Scrum and Springs in HEIs.

Of all the activities conducted, this was the only one that involved a cost to the university (USD 31,000 over 2 years including scholarship and salary). The return from this investment was 1.7 new master's degree students per year

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Table I. SET Master's degree enrolment from 2008 to 2015.

First-year student enrolment	2008	2009	2010	2011	2012	2013	2014	2015	Mean
Master's in Engineering Management (MEM)	–	–	–	–	–	–	–	32	–
Master's in Industrial and Systems Engineering (MISE)	15	15	9	14	6	10	22	15	13.3
Master's in Product Engineering (MPE)	8	7	12	7	4	10	8	8	8.0
Total without MEM	23	22	21	21	10	20	30	23	21.3
Growth rate without MEM		−1	−1	0	−11	10	10	−7	0.3
Annual growth rate without MEM		−4%	−4%	0%	−52%	100%	50%	−23 %	9.6%
Total	23	22	21	21	10	20	30	55	25.3
Growth rate		−1	−1	0	−11	10	10	25	4.6
Annual growth rate		−4%	−4%	0%	−52%	100%	50%	83%	24%

Table II. Gap between service quality perceptions and service quality expectation

	Perception (P)		Expectation (E)		Gap
Tangibles	Mean	Stud dev.	Mean	Std. dev.	Mean
01. Classroom appearance	3.93	0.97	4.28	0.57	*−0.35*
02. Classroom cleanliness	3.48	1.18	4.54	0.56	*−1.06*
03. W.C. cleanliness	3.64	1.03	4.73	0.44	*−1.09*
04. Access to the parking lot	2.42	1.15	4.64	0.57	*−2.22*
05. Service hours appropriate for students according to their needs	3.78	1.06	4.33	0.66	*−0.55*
06. Current material available in physical library	3.64	0.94	4.16	0.70	*−0.52*
07. Current material available in digital library	3.52	0.97	4.33	0.68	*−0.81*
08. Laboratories available in class to do academic work	3.67	0.87	4.03	0.81	*−0.36*
Tangibles average	*3.51*	*1.11*	*4.38*	*0.67*	*−0.87*
Reliability					
09. Class hours compliance (start and finish hours)	4.22	0.67	4.24	0.67	*−0.02*
10. Ability of professors to share knowledge	4.16	0.75	4.91	0.29	*−0.75*
11. Current knowledge of the professor in the subject	4.45	0.63	4.88	0.32	*−0.43*
12. Study plans fulfilment	4.18	0.71	4.51	0.61	*−0.33*
Reliability average	*4.25*	*0.70*	*4.63*	*0.57*	*−0.38*
Responsiveness					
13. Opportune information about services offered by the university	3.37	1.00	4.12	0.78	*−0.75*

14. Pertinent processing and solution of student requirements made to scholar services	3.60	0.98	4.24	0.60	*−0.64*
15. Timeliness and availability of staff to respond to incidentals	3.86	0.99	4.36	0.61	*−0.50*
16. Availability of student services staff	3.81	0.90	4.27	0.64	*−0.46*
Responsiveness average	*3.66*	*0.99*	*4.25*	*0.67*	*−0.59*
Assurance					
17. Application of knowledge gained during the study of the graduate programme directly in your field	4.16	0.80	4.76	0.43	*−0.60*
18. I perceived that the university is currently aware of my needs	3.57	0.95	4.14	0.77	*−0.57*
19. I feel secure in the university facilities	4.51	0.65	4.58	0.60	*−0.07*
Assurance average	*4.08*	*0.90*	*4.49*	*0.67*	*−0.41*
Empathy					
20. Kind treatment from the administrative staff when attending to student needs	4.24	0.79	4.43	0.63	*−0.19*
21. Availability of library staff to fulfil student needs	3.81	0.85	3.94	0.83	*−0.13*
22. Easy communication channels between administrative staff and students	3.93	0.82	4.21	0.72	*−0.28*
23. Personalised attention from the faculty towards the students	4.19	0.83	4.58	0.58	*−0.39*

24. Personalised attention from the graduate engineering programme director towards the students	4.12	0.95	4.46	0.63	*−0.34*
Empathy average	*4.06*	*0.87*	*4.33*	*0.72*	*−0.27*

Table IV. Gap mean hypothesis tests

Dimension	Hypothesis		*p* value
Tangible	*Gap* means for the tangibles dimension is equal between	Master's degree programmes (H1a)	0.093
		Gender (H1b)	0.562
		Age (H1c)	0.247
		Professional role (H1d)	0.473
Reliability	*Gap* means for the reliability dimension is equal between	Master's degree programmes (H2a)	0.190
		Gender (H2b)	0.622
		Age (H2c)	0.175
		Professional role (H2d)	0.040*
Responsiveness	*Gap* means for the responsiveness dimension is equal between	Master's degree programmes (H3a)	0.273
		Gender (H3b)	0.579
		Age (H3c)	0.038*
		Professional roles (H3d)	0.666
Assurance	*Gap* means for the assurance dimension is equal between	Master's degree programmes (H4a)	0.184
		Gender (H4b)	0.935
		Age (H4c)	0.066
		Professional role (H4d)	0.139
Empathy	*Gap* means for the empathy dimension is equal between	Master's degree programmes (H5a)	0.795
		Gender (H5b)	0.237
		Age (H5c)	0.392
		Professional role (H5d)	0.229

*$p < 0.05$.